

EXPLORATIONS AND SURVEYS FOR A RAILROAD ROUTE FROM THE MISSISSIPPI
RIVER TO THE PACIFIC OCEAN.—WAR DEPARTMENT.

APPENDIX

TO THE

PRELIMINARY GEOLOGICAL REPORT

OF

WILLIAM P. BLAKE,

GEOLOGIST OF THE SURVEY IN CALIFORNIA UNDER THE COMMAND OF LIEUT. R. S. WILLIAMSON.

PALEONTOLOGY.

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APPENDIX.

ARTICLE I.

REPORT OF MR. T. A. CONRAD ON THE FOSSIL SHELLS COLLECTED
IN CALIFORNIA BY WM. P. BLAKE, GEOLOGIST OF THE EXPEDITION
UNDER THE COMMAND OF LIEUTENANT R. S. WILLIAMSON, UNITED
STATES TOPOGRAPHICAL ENGINEERS.*

PHILADELPHIA, PA., *January*, 1855.

SIR: I have examined the very interesting organic remains which you collected in California, and the drawings of such species as were too fragile to preserve, and I herein submit a few remarks upon their geological relations. There appear to be several distinct groups; but I cannot pretend, from such scanty materials, to designate what particular formation every group represents. There is no obscurity resting on the deposits of Santa Barbara and San Pedro, which represent a recent formation, in which you inform me the remains of the mammoth occur. The shells are generally those which live in the adjacent waters, and indicate little, if any, change of temperature since their deposition. The littoral character of this formation is very evident. Water-worn shells and fragments show the action of the surf, whilst entire specimens of bivalves, and Pholadidæ, and Saxicavæ, remaining undisturbed in their self-excavated domicils, exhibit the same disposition of marine shells that is familiar to the observer on all sandy and argillaceous shores. They burrow in clay, mud, or sand, beyond the ordinary action of the surf; whilst some are scooped out by the tempest-driven surge, and others preyed upon by fishes and marine animals of various kinds, and are thus broken up and deposited among the living species.

Of the Eocene, and the recent formation alluded to, I can speak with confidence; but the intermediate beds are of uncertain age. The *Ostrea vespertina*, *Anomia subcostata* and *Pecten vespertinus*, occurring in the bank of Carrizo creek, are unlike any recent forms that I am acquainted with from the Pacific coast, but analogous to Miocene species of Virginia. This formation may, therefore, be regarded as of Miocene origin—an opinion in which I am confirmed by some

* The following reports on the fossil and recent shells were not received in season to be printed in connexion with the author's Preliminary Geological Report. It is deemed best to present these now, even without the plates, as several months will elapse before the drawings can be finished and printed for the 4th edition now preparing.

W. P. BLAKE.

JULY, 1855.

fossils collected in California by Dr. Heermann, consisting of decidedly Miocene forms; a *Mercenaria*, (*M. perlaminosa*,) Con., scarcely differing from a species of Cumberland county, N. J., (*M. Ducateli*, Con.), a *Cemoria*, *Pandora* and *Cardita* of extinct species, closely analogous to Miocene forms. I am inclined, also, to refer to this period a very different group from Ocoya creek, the forms of which you sketched in California, as the specimens were too friable to be preserved. I do not recognize any recent species among them, nor any contained in an Eocene deposit.

The rock at San Diego is replete with shells, generally of a small size, and appears to have a certain palæontological relation to those of Monterey, Carmello, and those in boulder specimens of Oregon, collected by Townsend and Dana, which I have referred to the Miocene period. Two species of San Diego, if not identical, approach Oregon shells; *Nucula decisa* is similar to *N. divaricata*, and both, in their markings, resemble *N. cobboldii* of the English Miocene. *Macra Diegoana* is nearly related to the Oregon *M. alboria*.

The Eocene period is unequivocally represented by the beautifully perfect shells from the Cañada de las Uvas, which, though not found in situ, are evidently derived from strata occurring on the Pacific slope of the Sierra Nevada. This is very remarkable, inasmuch as three species correspond with forms of Claiborne, Alabama, and seem to indicate a connexion of the Atlantic and Pacific oceans during the Eocene period. The vast distance between the two localities will account for the general distinction of species, and it was, indeed, an unexpected result to find any identical. If I had imagined any eastern species to occur in California, it would have been the very one which does occur, and, apparently, in abundance, that "finger-post" of the Eocene, *Cardita planicosta*, a fossil of the Paris basin, and also abundant in Maryland, Virginia, and Alabama. This species originated and perished in the Eocene period, and is so widely distributed that it may be regarded as the most characteristic fossil of its era. As the boulder from which these shells were derived was quite small, and yet furnished thirteen species, when it shall be investigated in situ, doubtless a great many other forms will be obtained, and very likely some with which we are already familiar in eastern localities. Although the rock is a very hard sandstone, the shells may be exposed in great perfection by careful management, and we look forward with great interest to their further development, and to the discovery of the rock in situ.

Respectfully, yours, &c.,

T. A. CONRAD.

WM. P. BLAKE, *Geologist of the United States*
Pacific Railroad Survey in California.

CATALOGUE.

I. EOCENE.

No.	Name.	Locality.
1	<i>Cardium linteum</i> , (nov. sp.) Con	Cañada de las Uvas.
2	<i>Dosinia alta</i> , (nov. sp.) Con	Do.
3	<i>Meretrix uvasana</i> , (nov. sp.) Con	Do.
4	——— <i>Californiana</i> , (nov. sp.) Con	Do.
5	<i>Crassatella uvasana</i> , (nov. sp.) Con	Do.
6	——— <i>alta</i> . Con	Do.
7	<i>Mytilus humerus</i> , (nov. sp.) Con	Do.
8	<i>Cardita planicosta</i>	Do.
9	<i>Natica ætites</i> . Con	Do.
10	——— <i>gibbosa</i> . Lea	Do.
11	<i>Turritella uvasana</i> , (nov. sp.) Con	Do.
12	<i>Volutathes Californiana</i> , (nov. sp.) Con	Do.
13	<i>Busycon</i> ? <i>Blakei</i> , (nov. sp.) Con	Do.
14	<i>Clavatula Californica</i> , (nov. sp.) Con	Do.

II. MIOCENE AND RECENT FORMATIONS.

15	<i>Cardium modestum</i> , (nov. sp.) Con	San Diego.
16	<i>Nucula decisa</i> , (nov. sp.) Con	Do.
17	<i>Corbula diegoana</i> , (nov. sp.) Con	Do.
18	<i>Meretrix uniomeris</i> , (nov. sp.) Con	Monterey county.
19	——— <i>decisa</i> , (nov. sp.) Con	Ocoya creek.
20	——— <i>tulurana</i> , (nov. sp.) Con	Tulare valley.
21	<i>Tellina diegoana</i> , (nov. sp.) Con	San Diego.
22	——— <i>congesta</i> , (nov. sp.) Con	Monterey, Carmello, and San Diego
23	——— <i>pedroana</i> , (nov. sp.) Con	San Pedro.
24	<i>Arca microdonta</i> , (nov. sp.) Con	Tulare valley?
25	<i>Tapes diversum</i>	San Pedro.
26	<i>Saxicava abrupta</i> , (nov. sp.) Con	Do.
27	<i>Petricola pedroana</i> , (nov. sp.) Con	Do.
28	<i>Schizotherus Nutalli</i> , (nov. sp.) Con	Do.
29	<i>Lutraria Traskei</i> , (nov. sp.) Con	Carmello.
30	<i>Macra diegoana</i> , (nov. sp.) Con	San Diego.
31	<i>Modiola contracta</i> , (nov. sp.) Con	Monterey county.
32	<i>Mytilus pedroanus</i> , (nov. sp.) Con	San Pedro.
33	<i>Pecten deserti</i> , (nov. sp.) Con	Colorado desert.
34	<i>Anomia subcostata</i> , (nov. sp.) Con	Do.
35	<i>Ostrea vespertina</i> , (nov. sp.) Con	Do.
36	——— <i>Heermanni</i> , (nov. sp.) Con	Do.
37	<i>Penitella speleum</i> , (nov. sp.) Con	San Pedro, (recent.)
38	<i>Fissurella crenulata</i> . Sow	Do.
39	<i>Crepidula princeps</i> , (nov. sp.) Con	Santa Barbara.
40	<i>Narica diegoana</i> , (nov. sp.) Con	San Diego.
41	<i>Trochita diegoana</i> , (nov. sp.) Con	Do.
42	<i>Crucibulum spinosum</i> (nov. sp.) Con	———?
43	<i>Nassa intastriata</i> , (nov. sp.) Con	San Pedro.
44	——— <i>pedroana</i> , (nov. sp.) Con	Do.
45	<i>Strephona pedroana</i> , (nov. sp.) Con	Do.
46	<i>Littorina pedroana</i> , (nov. sp.) Con	Do.
47	<i>Stramonita petrosa</i> , (nov. sp.) Con	Tulare valley.
48	<i>Gratelupia mactropsis</i> , (nov. sp.) Con	Isthmus of Darien.
49	<i>Meretrix dariena</i> , (nov. sp.) Con	Do.
50	<i>Tellina dariena</i> , (nov. sp.) Con	Do.
51	<i>Natica ocoyana</i> , (nov. sp.) Con	Ocoya or Posë creek.
52	——— <i>geniculata</i> , (nov. sp.) Con	Do.

II. MIOCENE AND RECENT FORMATIONS—Continued.

No.	Name.	Locality.
53	<i>Bulla jugularis</i> , (nov. sp.) Con.....	Ocoya or Posé creek.
54	<i>Pleurotoma transmontana</i> , (nov. sp.) Con.....	Do.
55	—— <i>ocoyana</i> , (nov. sp.) Con.....	Do.
56	<i>Syctopus ocyanus</i> , (nov. sp.) Con.....	Do.
57	<i>Turritella ocoyana</i> , (nov. sp.) Con.....	Do.
58	<i>Colus arctatus</i> , (nov. sp.) Con.....	Do.
59	<i>Tellina ocoyana</i> , (nov. sp.) Con.....	Do.
60	<i>Pecten nevadanus</i> , (nov. sp.) Con.....	Do.
61	—— <i>catillifornis</i> , (nov. sp.) Con.....	Do.
62	<i>Cardium</i> ——?.....	Do.
63	<i>Arca</i> ——?.....	Do.
64	<i>Solen</i> ——?.....	Do.
65	<i>Dosinia</i> ——?.....	Do.
66	<i>Venus</i> ——?.....	Do.
67	<i>Cytherea decisa</i> ? Con	Do.
68	<i>Ostrea</i> ——?.....	San Fernando.
69	<i>Pecten</i> ——?.....	Do.
70	<i>Turritella biseriata</i> , (nov. sp.?) Con	Do.
71	<i>Trochus</i> ——?.....	Benicia.
72	<i>Turritella</i> ——?.....	Do.
73	<i>Buccinum intastriatum</i> ?.....	San Pedro.
74	<i>Oliva pedroensis</i> , (nov. sp.?) Con	Do.
75	<i>Anodonta Californiensis</i> . Lea	Colorado desert.

DESCRIPTIONS OF FOSSIL SHELLS FROM THE EOCENE AND MIOCENE
FORMATIONS OF CALIFORNIA.

I. EOCENE.

CARDIUM, *Lin.*

1. *C. LINTEUM*, Conrad, pl. 1, fig. 1.—Cordate, ventricose subequilateral, with closely arranged radiating lines, umbonal slope subcarinated; posterior submargin with closely arranged smooth striae, fine, but much larger than those of the disk.

Locality.—Cañada de las Uvas. Allied to *C. Niccolleti*, Con., but very distinct.

DOSINIA, *Scopoli.*

2. *D. ALTA*, Con., pl. 1, fig. 2.—Elevated equilateral? posterior side short; disk with fine closely arranged concentric lines, becoming large towards the base; posterior extremity obtuse, direct.

Locality.—Cañada de las Uvas, with the preceding.

MERETRIX, *Lam.* CYTHEREA, *Lam.*

3. *M. UVASANA*, Con., pl. 1, fig. 3.—Suboval convex, inequilateral, margins rounded; beaks distant from anterior margin; disk with concentric, rather distant ribs, which were probably laminiform when perfect.

Locality.—Cañada de las Uvas.

There is but one broken valve of this species, in hard sandstone and with the ribs broken of.

4. *M. CALIFORNIANA*, Con., pl. 1, fig. 4.—Subcordate, ventricose, inequilateral; posterior extremity truncated somewhat obliquely inwards; basal margin nearly straight in the middle; lunule lanceolate; anterior extremity acutely rounded.

Locality.—Occurs at the Cañada de las Uvas, with the preceding species. Allied to *M. Poulsoni*, Con.

CRASSATELLA, *Lam.*

5. *C. UVASANA*, Con., pl. 1, fig. 5.—Subtriangular, compressed, concentrically sulcated above, and having a few slight concentric undulations inferiorly; ligament slope very oblique, rectilinear; anterior extremity regularly rounded.

Locality.—Cañada de las Uvas, with the preceding species.

6. *C. ALTA*, Conrad.—This species occurs in the same rock with the preceding, but only in small fragments. It appears to have been abundant, as it likewise is at Claiborne, Alabama. The fracture has resulted from breaking the rock, as the shell appears to have been perfect and not water-worn.

MYTILUS, *Lin.*

7. *M. HUMERUS*, *Con.*, pl. 1, fig. 10.—Ovate, ventricose, summit acute; anterior margin rectilinear; basal margin rounded; anterior extremity obtusely rounded; posterior extremity less obtuse; disk with minute radiating lines.

Locality.—Cañada de las Uvas, with the preceding fossils.

CARDITA, *Brug.*

8. *C. PLANICOSTA*, pl. 1, fig. 6.—Obliquely cordate; ribs about 22, broad and flattened, separated by a narrow groove which becomes obsolete towards the base; ribs on the posterior slope narrow, indistinct, and crossed by numerous profound wrinkles. Lunule small, cordate, profoundly impressed; inner margin crenate.

Locality.—Cañada de las Uvas, with the preceding fossils. *Venericardia planicosta* *Lam.* *An. Sans Vert.* (*Desh. ed.*) vol. vi., p. 381.

This common species occurs much larger, though less perfect, than the one represented. This shell occurs abundantly in the Eocene strata of Maryland, Virginia and Alabama, and is quite as characteristic of the American as of the European Eocene period. I discovered it in Maryland in 1829, and at that time regarded it as the first indication of the occurrence of deposits in the United States synchronous with those of the London clay. Prof. Rogers has since named this shell *Venericardia ascia*.

NATICA, *Adanson.*

9. *N. æTITES?* *Con.*, pl. 1, fig. 7.

Locality.—Cañada de las Uvas, with the preceding fossils.

N. ætites, *Conrad.*—*Foss. shells of Tert. Form.* October, 1833.

10. *N. GIBBOSA* and *SEMILUNATA*, *Lea. cont. to Geol.*, December, 1833. There is but one specimen of this shell, which I refer with doubt to a Claiborne species. The outline is similar to that of the latter, but the aperture is concealed in the rock, which prevents the necessary comparison to determine the identity or the difference.

2 *N. ALVEATA*, *Con.*, pl. 1, fig. 8 and 8a.—Volutions 5, flattened above, carinated on the angle, a few minute obsolete lines revolve on the upper side of the whorls; aperture inclining to an obovate form; umbilicus small.

Locality.—Cañada de las Uvas.

This species is remarkable for its truncated whorls, which are channelled by the carina on the margin. There are no analogous species in the Eocene of the Atlantic slope.

TURRITELLA, *Lam.*

11. *T. UVASANA*, *Con.*, pl. 1, fig. 12.—Subulate, whorls with the sides straight and oblique above, rounded below, and having large revolving striæ with intermediate minute lines; striæ near the suture on the upper part of the whorls finer than the prominent lines below.

Locality.—Occurs with the preceding, in Cañada de las Uvas.

This species is allied to *T. obruta*, Conrad, (*T. lineata*, Lea,) but that Clairborne shell differs in having fewer revolving lines, and in being indented at the suture.

VOLUTATITHES, Swains.

12. *V. CALIFORNIANA*, Con., pl. 1, fig. 9.—Resembles *V. Sayana*, Con., but smaller, having numerous rounded tubercles instead of the comparatively few spiniform ones of the latter. The tubercles are somewhat oblique; base with rather distant impressed lines.

Locality.—Cañada de las Uvas, with the preceding.

BUSYCON?

13. *B.?* BLAKEI, Con., pl. 1, fig. 13.—Fusiform, body whorl bicarinated; shoulder profoundly tuberculated; tubercles acute, transversely compressed; lower angle distant, entire. Surface covered with rather fine unequal or alternated wrinkled lines; upper side of the whorls flattened and sloping; whorls of the spire angulated and tuberculated in the middle.

Locality.—Cañada de las Uvas, with the preceding.

The beak of this shell being broken, its form and length are uncertain, and the aperture being concealed in the rock, the generic character can only be inferred from the contour of the shell. This corresponds with *Busycon*, except in the biangular form of the body whorl, in which respect it differs from any undoubted species that I have seen.

CLAVATULA? Swains.

14. *C.?* CALIFORNICA, Con., pl. 1, fig. 11.—Fusiform; spire conical, volutions rounded, somewhat flattened above; body whorl ventricose; beak short and narrow.

Locality.—Cañada de las Uvas, with the preceding. Allied to *C. prorata*, Con., of the Clairborne Eocene, but proportionably narrower.

II. FOSSILS OF THE MIOCENE AND RECENT FORMATIONS OF CALIFORNIA.

CARDIUM, Lin.

15. *C. MODESTUM*, (N. S.) Con., pl. 2, fig. 15.—Very small; ribs about 22, narrow; concentric wrinkled lines on the disk; posterior margin direct, truncated; umbonal slope angular; ligament margin parallel with the basal, and forming nearly a right angle with the posterior margin.

Locality.—San Diego.

NUCULA, Lam.

16. *N. DECISA*, (N. S.) Con., pl. 2, fig. 19.—Suboval or sub-rhomboidal, posterior margin obliquely truncated; disk with devaricating striæ.

Locality.—San Diego, with the preceding.

This species resembles, in its divaricating striae, *N. divaricata* of the Oregon Miocene; but the lines are proportionally larger, and the shell is smaller and different in outline.

CORBULA.

17. *C. DIEGOANA*, Con., pl. 2, fig. 16.—Triangular, ventricose, inequilateral, extremities subangulated: anterior margin very oblique, rectilinear; posterior margin forming with the ligament margin a slightly curved line, about equal in obliquity to the anterior margin; basal margin profoundly and nearly equally or regularly rounded.

Locality.—Mission of San Diégo.

MERETRIX, Lam.

18. *M. UNIOMERIS*, Con., pl. ii, fig. 20.—Ovate, very inequilateral, convex; posterior side cuneiform: ligament margin very oblique, rectilinear; posterior extremity truncated, direct; beak distant from anterior margin.

Locality.—Monterey county, 18 miles south of Trés Piños, in sandstone.

19. *M. DECISA*, Con., pl. ii, fig. 27.—Subquadrate, convex, very inequilateral; ligament slope very oblique, nearly straight; posterior extremity truncated; cardinal and lateral teeth robust. (Cast.)

Locality.—Ocoya creek, in friable ferruginous coarse sandstone. (For the associate fossils, see plates vi, vii, and viii.)

20. *M. TULARANA*, Con., pl. ii, fig. 22 and 22a.—Suboval or subtriangular, inequilateral convex anteriorly; compressed and cuneiform posteriorly, anterior extremity acutely rounded and as nearly in a line with the beak as the base; basal margin tumid medially; posterior extremity subtruncated.

Locality.—Tulare valley.

[NOTE.—This specimen is a clay cast, and was found in a boulder that had been washed down from the hills at the head of the Tulare valley, about twenty miles west of the Cañada de las Uvas.

W. P. B.]

TELLINA, Lin.

21. *T. DIEGOANA*, Con., pl. ii, fig. 28.—Ovate-elliptical, compressed, inequilateral, concentrically striated. Slope carinated; posterior extremity suddenly produced or rostrated, and below the posterior basal margin.

Locality.—San Diégo, in sandstone.

22. *T. CONGESTA*, Con., pl. ii, fig. 14, 18, 21.—Subtriangular, ventricose, inequilateral; anterior margin obliquely truncated; anterior basal margin sub-rectilinear, oblique, extremity angulated,

much above the line of the base ; posterior margin and posterior basal margin regularly rounded.

Localities.—Monterey ; Mission of San Diégo ; Carmello.

This interesting species is very abundant at Monterey, in indurated drab-colored clay. There is merely a chalky trace of the shell remaining. It occurs in a somewhat similar rock at Carmello, and in sandstone at San Diégo. Figure 21 is from San Diégo ; 22 from Monterey, and 23 from Carmello.

23. *T. PEDROANA*, (N. S.), Con., pl. 2, fig. 17.—Subtriangular, inequilateral, compressed ; anterior dorsal margin oblique, rectilinear ; anterior extremity truncated, posterior margin regularly rounded, basal margin subrectilinear.

Locality.—San Pedro. Recent formation.

A thin smooth species, of which only one valve was obtained.

ARCA, *Lin.*

24. *A. MICRODONTA*, Con., pl. 2, fig. 29.—Rhomboidal, ventricose, thick in substance ; anterior side very short ; umbonal slope rounded. Ribs 25, prominent, narrow, wider posteriorly, except on the posterior slope, where they are small and not prominent, about five in number. Cardinal teeth small, numerous, closely arranged, larger towards the extremities. Inner margin profoundly dentate ; dorsal area rather wide and marked with about six impressed lines ; beaks distant.

Locality.—Tulare valley ? Miocene.

There is but one valve in the collection, and it has some resemblance to *A. arata*, Say, of the Maryland Miocene. The locality is given by Mr. Blake with a mark of doubt.

TAPES.

25. *T. DIVERSUM*, Sow., pl. ii, fig. 24, 24*a*, and 26.—Obtusely oval or suborbiculary ventricose, inequilateral ; disk with numerous radiating prominent striæ or ribs, and concentric wrinkled lines, which are profound anteriorly ; posterior margin nearly direct, obtusely rounded or subtruncated ; inner margin with small crenulations ; ligament plate broad and profoundly indented.

Locality.—San Pedro, in calcareous marl. Recent formation.

SAXICAVA, *Fleur de Bell.*

26. *S. ABRUPTA*, Con., pl. ii, fig. 25 and 25*a*.—Suboval, ventricose, inequilateral ; concentrically wrinkled ; anterior margin obtusely rounded obliquely inwards ; posterior extremity truncated, direct, dorsal and basal margin nearly parallel.

Locality.—San Pedro. Recent formation.

PETRICOLA, *Lam.*

27. *P. PEDROANA*, Con., pl. ii, fig. 23.—Elliptical, profoundly inequilateral, compressed, undulated concentrically, and with very minute closely-arranged radiating lines.

Locality.—Occurs with the preceding shell. Recent formation.

One broken valve of this species occurred in the same specimen of rock in which they had bored. Some specimens of the *Saxicava* are entire, and fill the cavities they have formed, when living.

SCHIZOTHERUS, *Conrad*.

28. *S. NUTTALLI*, *Con.*, pl. iii, fig. 33 and 33*a*.—Ovate, ventricose, gaping widely posteriorly; moderately thick in substance; anterior side short, abruptly rounded at the extremity; posterior side elongated, extremely truncated; dorsal line slightly concave; umbo not prominent; basal margin profoundly rounded; hinge-plate broad, cartilage pit large, obliquely ovate, profound; cardinal teeth in the left valve two, one in the right valve; anterior cardinal plate broad, with an angular depression throughout its entire length, posterior one narrow, with a deep angular channel in which is a bifid plate in the right valve; cavity of shell and umbo profound.

Locality.—San Pedro in calcareous marl. Recent formation.—*W. P. Blake*.

I have referred this shell to the same genus in which I placed *Lutraria Nuttalli* of the California coast. The hinge is very similar to that of *Lutraria*, but the long deep channels of the hinge are similar to those of *L. Nuttalli*, the animal of which differs from that of *Lutraria*. I do not know of any recent species of the latter genus in California.

LUTRARIA? *Lam.*

29. *L. TRASKI*, *Con.*, pl. iii, fig. 30.—Suboval, ventricose, inequilateral, hinge and basal margin nearly parallel; posterior margin subtruncated and slightly oblique, or approaching a direct outline; posterior extremity rounded.

Locality.—Carmello. Miocene? (Received from John B. Trask, by whom it was collected.—*W. P. B.*)

MACTRA, *Lin.*

30. *M. DIEGOANA*, *Con.*, pl. iv, fig. 35.—Triangular ventricose, inequilateral, anterior side oblique, rectilinear; umbonal slope carinated and nearly terminal; basal margin profoundly and regularly rounded.

Locality.—San Diego. Miocene?

This species is nearly allied to *M. albaria* of the Oregon Miocene, which probably belongs to the same rock as the present species. The concentric ridges represented in the figure are caused by weathering, as the disk was originally smooth.

MODIOLA, *Lam.*

31. *M. CONTRACTA*, *Con.*, pl. iv, fig. 35.—Elongated, narrowed, anteriorly, contracted submedially; basal margin widely contracted; disk with numerous minute radiating lines.

Locality.—Monterey Co., 18 miles S. of Trés Pimos. Recent formation.

A portion of the shell remains, showing traces of fine radiating lines. Miocene?

MYTILUS, Lin.

32. *M. PEDROANUS*, Con., pl. —, fig. 40.—Oblong-subovate, ventricose, dorsal line unguled medially, angle rounded; beak projecting slightly beyond the basal margin; posterior extremity rounded; basal margin rectilinear.

Locality.—San Pedro. Recent formation.

PECTEN, Lin.

33. *P. DESERTI*, Con., pl. —, fig. 41.—Suborbicular, both valves convex; ribs about 23, rounded, somewhat flattened toward the base, about as wide as the interstices; in the lower valve much wider than the interstices, and the valve more convex than the opposite one; ears equal in the upper valve; left ear of lower valve extended downwards and very obliquely striated; cartilage pit profound; a submarginal channel parallel with the upper margin.

Locality.—Carrizo creek, Colorado desert. Miocene.

ANOMIA, Lin.

34. *A. SUBCOSTATA*, Con., pl. —, fig. 34.—Obtusely ovate, thick in substance, umbo of larger valve ventricose, hinge thickened; surface of this valve obtusely undulated concentrically and marked with waved, wrinkled, very irregular interrupted ribs, not much raised except toward the base, where they are larger and somewhat tuberculiform, upper valve entire, or with obsolete radii toward the base.

Locality.—Carrizo creek, Colorado desert. Miocene.

Allied to *A. Ruffini* of the Virginia Miocene, but thicker, less expanded, and with the radii more numerous and more rib-like.

OSTREA, Lin.

35. *O. VESPERTINA*, Con., pl. —, figs. 36, 37, 38.—Ovate, subfalcate, lower valve plicated or ribbed more or less profoundly; hinge long and wide, sharp and somewhat pointed; ligament cavity wide, profound, minutely wrinkled; margins abrupt; cavity not very deep; muscular impression large, impressed; upper valve flat, irregular, plicated on the margin; a submarginal furrow, slightly impressed, crenulated nearly to its basal curve, profoundly crenulated towards the hinge.

Locality.—Carrizo creek. Miocene.

O. vespertina. Con. Jour. Acad. Nat. Sc., new series, vol 2, part 4, p. 300.

This species is very similar in form and plications to *O. subfalcata*, Con., of the Virginia Miocene.

36. *O. HEERMANNI*, Con. Acad. Nat. Sc., Philadelphia.—Very irregular in form, thick, ovate and often dilated; lower valve shallow; exterior very irregular, with large distant angular radiating ribs, and with pits, irregular cavities; cartilage pit broad and oblique: upper valve flat or concave, with a profoundly irregular surface. Length $5\frac{3}{4}$ inches, height $6\frac{1}{2}$ inches.

Locality.—Carrizo creek, Colorado desert. Dr. Heermann.

This large oyster shell probably belongs to the same deposit which contains *O. vespertina* and *Anomia subcostata*. The surfaces of most specimens have a resemblance to worm-eaten wood, having been evidently sculptured by some marine animal.*

PENITELLA.

37. *P. SPELÆUM*, Con., pl. —, 43, 43a, 43b.—Ovate, ventricose, anteriorly inflated with fine radiating lines and transverse wrinkles, transverse furrow medial, angular, slightly oblique; posterior side crumeform, truncated at the extremity, which is direct, and with prominent, acute, wrinkled concentric lines; front dorsal margin widely recurved, trisulcate; cardinal plate broad, sulcated process slender, direct.

Locality.—San Pedro. Recent formation.

No trace of the coriaceous cup, characteristic of this genus, remains in the collection. It is widely distinct from the recent species of the California coast, *P. penita*, Conrad.

FISSURELLA, Lam.

38. *F. CRENULATA*, Sow., pl. —, fig. 44.—Oblong subovate, slightly contracted laterally opposite the foramen. Shell with numerous radiating conspicuous compressed lines; foramen large, subovate, not nearly central; inner margin crenulated, thickened basal margin sinous; inner margin of foramen broadly callous; cavity profound.

F. crenulata, Sowerby, Zankerville catalogue.

Locality.—San Pedro. Recent formation. This is the largest fossil species I have seen.

CREPIDULA, Lam. CRYPTA, Humph.

39. *C. PRINCEPS*, Con., pl. —, fig. 52.—Oblong, ovate, thick and ponderous, contracted or compressed superiorly; upper side or portion of the shell sloping; back regularly rounded; beak prominent, rounded, laterally curved; apex distant from the margin of the aperture; diaphragm very large, with a very sinuous margin.

Locality.—Santa Barbara. Recent formation.

This is the largest species that has come under my observation, and is very distinct from any that has yet been described.

NARICA.

40. *N. DIEGOANA*, Con., pl. —, fig. 39.—Subglobose, sides flattened; obtuse above.

Locality.—San Diego. Miocene?

Partially embedded in the rock and its form not accurately determined.

* These specimens were picked up by Dr. Heerman in the bed of the creek, and were undoubtedly derived from a portion of the stratum of shells that I found in situ.

TROCHITA, *Schum.*

41. *T. DIEGOANA*, Con., pl. —, fig. 42.—Conical; volutions three, rounded, smooth; body whorl ventricose.

Locality.—Occurs with the preceding. Miocene?

CRUCIBULUM, *Shum.*

42. *C. SPINOSUM*, Con., pl. —, fig. 46.—Moderately elevated, suboval, armed with numerous prominent spines in radiating series: spines smaller, and the series more closely arranged anteriorly; apex sub-central? prominent, acute; shell with concentric wrinkles.

Calyptræa spinosa?—*Sowerby*.

Locality.—San Diego? Recent on the coast of Peru.

NASSA, *Lam.*

43. *N. INSTASTRIATA*, Con., pl. —, fig. 49.—Ovate-acute; whorls $5\frac{1}{2}$ rounded, cancellated; longitudinal striae nodulous, except towards the base of body whorl; a deep sulcus behind the beak, two upper volutions entire; labrum striated within; spire conical, longer than the aperture.

Locality.—San Pedro. Recent formation.

The surface of this shell is roughened by a tubercle on the longitudinal, at each intersection of the revolving lines.

44. *N. PEDROANA*, Con., pl. —, fig. 48.—Subfusiform, smooth; volutions rounded, spire conical, longer than the aperture, which is elliptical; columella very regularly concave.

Locality.—Occurs with the preceding. Recent formation.

This small species resembles *Nassa lunata*, Say, as the preceding approximate *N. trivittata*, Say. This is very remarkable, as the two latter are recent shells of the Atlantic coast, associated with each other, both in the sea and in the Miocene deposits of Virginia and Maryland.

STREPHONA, *Browne.* OLIVA, *Lam.*

45. *S. PEDROANA*, Con., pl. —, fig. 51.—Small, elliptical; spire conical, about equal in length to the aperture; base of columella with a prominent fold.

Locality.—Occurs with the preceding. Recent formation.

A small abundant species, sometimes water-worn, without any prominent character, except the fold at the base which is more conspicuous, considering the size of the shell, than is usual in the genus.

LITTORINA, *Ferr.*

46. *L. PEDROANA*, Con., pl. —, fig. 50.—Suboval; spire very short; body whorl abruptly rounded above; aperture obliquely subovate.

Locality.—Occurs with the preceding. Recent formation.

STRAMONITA, *Shum.* PURPURA, *Lam.*

47. *S. PETROSA*, Con., pl. —, fig. 47 and 47a.—Subglobose; whorls 4, subangulated; body whorl with 3 revolving rows of distant tuber-

cles, and flattened at the summit. Spire conical; penultimate whorl with one series of tubercles.

Locality.—Tulare Valley. (Found with *Meretrix Tularana*, Con., pl. ii, fig. 22 and 32a. Both specimens are clay casts, but very perfect.—*W. P. B.*)

III. TERTIARY SHELLS OF THE ISTHMUS OF DARIEN.

MIOCENE:

Mr. Blake has forwarded me casts of three bivalves. They are forms which are new to me, and probably Miocene species. The *Gratelupia*, except in being truncated posteriorly, much resembles *G. Hydeana*, Conrad, an Eocene fossil.

GRATELUPIA? *Desmoulin*.

48. *G.*? *MACTROPSIS*, Con., pl. —, fig. 54.—Triangular. inequilateral; dorsal margins equally oblique, straight; basal margin rounded anteriorly, slightly curved, posteriorly. posterior extremity truncated, direct, considerably above the line of the base.

Locality.—Isthmus of Darien.

MERETRIX.

49. *M. DARIENA*, Con., pl. —, fig. 55.—Obtusely and obliquely subovate; ventricose; inequilateral; anterior extremity angulated and situated much nearer the beak than the base; anterior dorsal line straight and oblique; beak not prominent; basal and posterior margins profoundly rounded.

Locality.—Occurs with the preceding.

TELLINA, *Lin.*

50. *T. DARIENA*, Con., pl. —, fig. 53.—Subtriangular, compressed; anterior hinge-margin rectilinear, very oblique, extremity truncated, direct; posterior extremity regularly rounded; base moderately curved.

Locality.—Occurs with the preceding.

IV. MIOCENE FOSSILS FROM OCOYA CREEK.

The following are descriptions of some of the fossils from Ocoya creek, (Posé creek,) which occur only as casts. The collection contains many of these casts, but the descriptions are principally based upon the drawings made at the locality by Mr. Blake.

NATICA.

51. *N. OCOYANA*, Con., pl. vi, fig. 57.—Spire conical, volutions three or four, rounded on the sides, depressed above; body whorl very wide, depressed.

Locality.—Ocoya creek.—*W. P. Blake.*

52. *N. GENICULATA*, Con., pl. vi, fig. 67.—Globose, volutions angulated above; spire short, conical; body whorl contracted near the summit.

Locality.—Ocoya creek.—*W. P. Blake.*

Resembles *N. alveata*. Con., of the California Eocene. (See p. 10.)

BULLA.

53. *B. JUGULARIS*, Conrad, pl. vi, fig. 62, 62*a*, 62*b*.—Oblong elongated, much contracted toward the apex; acutely rounded at the base.

Locality.—Ocoya creek.—*W. P. Blake*.

PLEUROTOMA.

54. *P. TRANSMONTANA*, Conrad, pl. vi, fig. 69.—Fusiform, with rugose revolving lines and distant short longitudinal undulations on the body whorl; volutions of the spire rounded; longitudinally undulated.

Locality.—Ocoya creek.—*W. P. Blake*.

55. *P. OCOYANA*, Conrad, pl. vi, fig. 71.—Short fusiform body, whorl ventricose, contracted near the suture, surface marked with revolving lines and numerous longitudinal furrows.

Locality.—Ocoya creek.—*W. P. Blake*.

SYCOTOPUS.

56. *S. OCOYANUS*, Conrad, pl. vi, fig. 72.—Spire depressed; whorls flattened above; shoulder sub-angulated, sides somewhat flattened, columella profoundly rounded above and concave below.

Locality.—Ocoya creek.—*W. P. Blake*.

TURRITELLA.

57. *T. OCOYANA*, Conrad, pl. vii, figs. 73, 73*a*, 73*b*.—Volutions 13 or 14, straight at the sides, rounded at base, and having well marked revolving lines, base broad; volutions suddenly tapering to the apex.

Locality.—Ocoya creek.—*W. P. Blake*.

COLUS.

58. *C. ARCTATUS*, Conrad, pl. vii, fig. 76.—Narrow fusiform whorls rounded; beak very slender, somewhat sinuous.

Locality.—Ocoya creek, Cal.—*W. P. Blake*.

TELLINA.

59. *T. OCOYANA*, Conrad, pl. vii, fig. 75.—Elliptical compressed inequilateral; posterior extremity acutely rounded, much above the line of the base; anterior end somewhat acutely rounded; cardinal teeth robust.

PECTEN.

60. *P. NEVADANUS*, Conrad, pl. vii, fig. 77. Ovate, flat or slightly concave; ribs 17? large, flattened on the back; interstices strongly wrinkled transversely.

This shell is so much nearly allied to *N. Humphreysii* of Maryland, that, taken in connexion with *P. Catillifornis*, pl. viii, it may be regarded as a Miocene species. The strata in which they occur may safely be referred to that period.

Locality.—Ocoya creek.—*W. P. Blake*.

61. *P. CATILLIFORNIS*, Conrad, pl. viii, fig. 83.—Orbicular plano-convex, with radiating striae and distinct rounded ribs: ears equal.

Locality.—Ocoya creek.—*W. P. Blake*.

This large Pecten has such a general resemblance to *P. Madisonius*, Say, of the Virginia Miocene, that I have no doubt it existed at the same period, or at least after the Eocene. There is none such now living on the coast of California, and none in the Eocene, of this group of large Pectens, which occur almost everywhere in the Miocene deposits of the Atlantic slope.

In addition to the above described species, there are many specimens and drawings in which the specific characters are not preserved with sufficient distinctness for description. Among these are individuals of the genera *Cardium*? or *Area*, *Solen*, *Dosinia* and *Venus*.

REMARKS IN CONCLUSION.

BY W. P. BLAKE.

From this report by Mr. Conrad, we find that in the collection of 61 determinable species, 55 are new and are now described for the first time. Of these, 10 are from one locality at the southern extremity of the Tulare valley, at the entrance to the pass called the Cañada de las Uvas. They are considered to be of the age of the Eocene by Mr. Conrad, who notes the similarity between three of the species and those of the Alabama Eocene deposits at Claiborne.—(See Mr. Conrad's letter.) These fossils were imbedded in a boulder of compact sandstone that had been washed out of the ravine of the pass by floods. The rock was not found *in situ* at that point, but a few miles to the westward a similar rock occurs in place, and is replete with fossils. These are believed to be the first fossils of Eocene age that have been procured from the Pacific slope of the United States.

The sedimentary formations of Ocoya creek (Posé creek) are considered to be of the age of the Miocene, and twelve new species from that locality are described. There were numerous specimens of other species in the collection, which were not sufficiently characteristic for determination, but which are probably new. Eight new species of Miocene shells are described from San Diego, and ten of a more recent formation from San Pedro. These last occur in a bank fronting the bay, and which is partly undermined by the surf. This bank is filled with shells, and the principal stratum is about 30 feet above tide.

The fossils from the sandstones along Carrizo creek, near the point where it spreads out and is lost in the desert, are all new and of Miocene age.

The Miocene formation appears, therefore, to flank the Peninsula Sierra on both sides in the latitude of San Diego, and to underlie the alluvial deposits or delta of the Colorado. There is a remarkable difference in the appearance of the fossils on the east and west sides of this chain. Those on the desert side form a stratum four or five feet thick of shells alone, consisting almost wholly of the genera *Ostrea*,

Anomia and Pecten: while on the west side, bordering the Pacific, there is a greater variety of genera and species; shells of the genera *Cardium*, *Nucula*, *Corbula*, *Tellina*, *Macra*, *Narica* and *Trochita* being abundant. An interesting relationship between the existing and fossil shells of the Gulf side of the chain is indicated, and it is probable that the crest of the chain divided the waters of the Gulf and the Pacific during the Miocene era.

At the pass of San Fernando, between Los Angeles and the granitic mountains, the sandstone strata contain numerous fossils, and fragments of shells belonging to the genera *Ostrea*, *Pecten*, and *Turritella* were procured. These, being imperfect, have not been specifically described by Mr. Conrad.

At Navy Point, Benicia, I obtained several casts of shells in an imperfect state, and, also, a small shark's tooth. The shells were probably of the genera *Trochus* and *Turritella*. Numerous specimens of lignite were also found at that place, imbedded in the compact sandstone.

At San Francisco, on the west side of the peninsula, near the lagoon on the beach, numerous specimens of fossil *Spatangi* are thrown up by the surf. They are inclosed in a matrix of bluish-green sand, resembling in color and composition the blue sandstone of the bay. It is, however, more friable, and seems to consist of the debris of the strata.

The town of Monterey is built over the line of junction of the granite of Point Piños, with an extensive series of tertiary strata, remarkable for containing immense deposits of the remains of Infusoria. These remains form white beds of siliceous earth, intercalated with semi-opaline strata of a very compact texture. They are now upraised nearly 500 feet above the water of the bay. Portions of the underlying strata—those in which the *Tellina congesta*, Con., occurs so abundantly—are also charged with small chambered shells, (*Polysphæria*, Foraminifera of D'Orbigny,) and offer a rich treat to the micro-geologist. With the aid of a glass thousands of these little shells can be seen on the fractured surfaces of the rock.

From this report, and the preceding remarks, it will be seen that fossils in sufficient numbers to determine the geological age of the deposits in which they occur have been obtained from many and distant points on the Pacific coast.

The occurrence of Eocene strata at one point has been satisfactorily established. We also find that the Miocene division of the tertiary formations is extensively developed, over broad areas, in California, flanking nearly all the great lines of elevation, not only in the coast mountains, but in the interior, along the borders of the San Joaquin and Tulare valleys. Further observations are required to connect, chronologically, the Miocene deposits along Ocoya creek with the extensive, and in many respects similar, strata further north, along the Tuolumne and Stanislaus rivers.

ARTICLE II.

CATALOGUE OF SHELLS COLLECTED IN CALIFORNIA BY W. P. BLAKE
WITH DESCRIPTIONS OF THE NEW SPECIES, BY AUGUSTUS A.
GOULD, M. D.

The collection consists of fresh-water shells from the Colorado desert and other localities; and of marine shells from the coast between San Francisco and San Diego. The new species are indicated in the catalogue by an asterisk. (*)

CATALOGUE.

No.	Name.	Locality.
1	<i>Ostrea</i>	San Diego.
2	<i>Pecten latiuaratus</i> , Conrad	Do.
3	<i>Pecten</i> (3).....	Do.
4	<i>Mytilus edulis</i> , (1).....	San Francisco.
5	<i>Modiola capax</i> , Conrad	San Diego.
6	<i>Venus Nuttallii</i> , Conrad.....	San Pedro.
7	<i>Venus fluctifraga</i> , Sowb.....	San Diego.
8	<i>Tapes grata</i> , Say, <i>T. discors</i> , Sowb., (straminea, Conrad).....	San Pedro.
9	* <i>Tapes gracilis</i> , Gould.....	Do.
10	<i>Cyclas</i> , (imperfect).....	Colorado Desert.
11	* <i>Cardium cruentatum</i> , Gould.....	San Diego.
12	<i>Lucina orbella</i> , Gould.....	San Pedro.
13	<i>Lucina Nuttallii</i> , Conrad.....	Do.
14	<i>Mesodesma rubrotincta</i> , (?) Sow.....	Do.
15	<i>Tellina vicina</i> , Adams.....	San Diego.
16	<i>Tellina secta</i> , Conrad.....	San Pedro.
17	<i>Sphenia Californica</i> , Conrad.....	San Diego.
18	<i>Petricola cylindracea</i> , Desh, (<i>P. carditoides</i> , Conrad).....	Monterey—San Pedro.
19	<i>Solecurtus Californiensis</i> , Conrad.....	San Diego.
20	<i>Gnathodon Lecontei</i> , Conrad.....	Colorado Desert.
21	<i>Lottia scabra</i> , Gould.....	San Francisco.
22	<i>Lottia patina</i> , Eschholtz.....	San Pedro.
23	<i>Lottia mitra</i> , Brod.....	Do.
24	<i>Calyptrea hispida</i> , Brod.....	San Pedro—San Diego.
25	<i>Crepidula incurva</i> , Brod.....	San Pedro.
26	<i>Bulla nebulosa</i> , Gould.....	San Diego.
27	<i>Bulla</i> (<i>Haminea</i>) <i>virescens</i> , Sow.....	Do.
28	* <i>Bulla</i> (<i>Haminea</i>) <i>vesicula</i> , Gould.....	Do.
29	* <i>Bulla</i> (<i>Tornatina</i>) <i>inculta</i> , Gould.....	Do.
30	<i>Trochus mæstus</i> , Jonas.....	Do.
31	* <i>Phasianella compta</i> , Gould.....	Do.
32	<i>Littorina</i> , (undetermined).....	
33	<i>Melampus</i> , (undetermined).....	Do.
34	<i>Oliva buplicata</i>	San Pedro.
35	* <i>Potamis pullatus</i> , Gould.....	San Diego.
36	* <i>Amnicola protea</i> , Gould.....	Colorado Desert.
37	* <i>Amnicola longinqua</i> , Gould.....	Do.
38	* <i>Planorbis ammon</i> , Gould.....	Colorado Desert—Ocoya Creek.
39	* <i>Physa humerosa</i> , Gould.....	Colorado Desert.
40	<i>Succinea</i> , (undetermined).....	Ocoya Creek.

The following are descriptions of species believed to be new. Two or three species are left undetermined in consequence of the specimens being imperfect, or the means for deciding being deficient :

FOSSIL FRESH-WATER SHELLS FROM THE COLORADO DESERT.

PHYSA HUMEROSA, Gould.

T. solidula, subrhomboidea, polifa; spira acuta, anfractibus 5 tabulatis; apertura $\frac{1}{2}$ ad $\frac{2}{3}$ long. test adequans, porticè obtusa; labro expanso, columellâ vix plicatâ.—*Pl. —, fig. —.*

Shell rather large and solid. subrhomboidal, polished : all the specimens seen, (quite numerous, and apparently not weathered,) porcelain white. Whorls five, each with a broad square shoulder, and forming an elevated, acute spire, aperture usually about two-thirds the length of the shell, sometimes but little over one-half; posterior angle obtusely rounded; outer lip slightly flaring; when viewed in profile it is slightly advanced posteriorly so as to form a recess at the junction; pillar without any conspicuous fold, thickly covered with enamel, broadly rounded and expanded at the base. Umbilical region nearly perforate.

Length on an ordinary specimen, half an inch; breadth, three-eighths of an inch: length of a variety, seven-tenths of an inch.

Found in the Colorado desert, by W. P. Blake, also at Pecos River, by Dr. T. H. Webb.

The broadly tabulated whorls, with the acute, elevated spire and folded pillar, clearly distinguish this species. *P. tabulata*, Gould, from New Zealand, is similar, as well as some varieties of *P. ancillaria*, Say, as figured by Haldeman, especially his figure 7, which he designates as a monstrosity; but the spire is more elevated, and the deep suture always renders the whorls distinct, and the absence of a columellar fold is a still further distinctive mark. It would be difficult to distinguish the young by themselves from several other species, though they begin to show the angularity of the whorls quite early.

PLANORBIS AMMON, Gould.

T. magna, discoidea, subconica, subtiliter, striata; latere sinistrolate et profundè, concavo, anfractus quatuor obtusè angulatos exhibente; latere dextro excavato, anfractus duos cum dimidis ostendente: apertura ovata-triangularis, interdum utroque valde expansa. *Pl. —, fig. —.*

Shell discoidal, attaining a large size, delicately striated, of a watery white color; when laid upon the right side, the shell has a remarkably conical or dome-shaped aspect, the extreme periphery being in a plane with the right side, or base, from which the whorl gradually slopes upwards, terminating at the summit in a broad and deep concavity, exhibiting four well marked, obtusely angulated whorls: the right side is decidedly concave, exhibiting two and a half or three well rounded volutions. Aperture ovate-triangular, in

middle-sized specimens projecting about equally to either side, in small specimens projecting to the right side only, and in the largest, spreading amply to both sides, and especially the right, where it expands and forms a remarkable ear-shaped aperture.

Diameter of the disk, in the middle-sized specimens, five-eighths of an inch, and in the largest, one inch; axial diameter of the first, one-fourth of an inch, of the latter, half an inch; and in one specimen the breadth of the aperture, from side to side, is five-eighths of an inch.

Locality.—Found in the Colorado desert; and also by Dr. Webb.

I have associated specimens differing greatly in size and in development of the aperture, but all agreeing in the peculiar slope of the outer volution, giving a conical outline when lying on the side. The fully developed specimens have the general aspect of *P. corpulentus*, Say; but besides the form of the volution and the consequent shape of the aperture, that shell is more coarsely striated, and the whorls on the right side lie nearly in the same place, and on the left side but two whorls appear. It differs from *P. tricoloris*, Say, in nearly the same particulars. In external surface it is more like *P. glabratus*, Say.

AMNICOLA PROTEA, Gould.

T. parva, elongata, gracilis variabilis; anfractibus 7–8 convexis, profundè, discretis, simplicibus, vel filis volentibus et costis longitudinalibus variè ornatis et clathratis; apertura ovata; labro continuo, simplici, anfractum penultimum vix attigente. Pl. —, fig. —.

Shell small, turretted, slender, greatly elongated, chalky white. (so far as seen,) variously proportioned, composed of seven or eight whorls, which are either convexly rounded or broadly shouldered, and separated by a deep suture—the surface either smooth throughout or more frequently sculptured with revolving threads or longitudinal ribs or decussated by both in various proportions, the upper whorls being in nearly every instance decussated, aperture ovate, lip simple, continuous, generally detached from, or scarcely appressed to the penultimate whorl, in many instances leaving an umbilical chink.

Largest specimens three-tenths of an inch long and half an inch broad.

Found in the Colorado desert; also by Dr. T. H. Webb.

This species is peculiar on account of its elongated, slender form, and differs from the other species of the genus yet described in being variously sculptured with revolving ridges and longitudinal folds like many of the *Melaniae*. It varies greatly also in its relative proportions of length and breadth. It is as slender as *A. attenuata*, Hal-deman, and much larger.

AMNICOLA LONGINQUA, Gould.

T. parva, elongato-ovata laevis, apice obtuso, spirx anfractibus quinque rotundatis, suturà profundà discretis; apertura elliptica, posticè, rotundata; columellà profundè arcuatà. Pl. —, fig. —.

Shell small, elongate ovate, horn-colored, (or blanched chalky white,) surface quite smooth; apex obtuse, whorls five, well rounded and sep-

arated by a deep suture. Aperture elliptical, broadly rounded posteriorly; lip simple, copiously incrusting the pillar margin, which is profoundly arcuate: umbilical region nearly perforate.

Length one-eighth of an inch, breadth one-tenth of an inch.

Found in the Colorado desert.

In form it is much like *A. Cincinnatiensis*. Haldeman, or like *A. galbana*.

II. MARINE SHELLS FROM THE COAST.

POTAMIS PULLATUS, Gould.

Testa turrita, gracilis, solida, rudis furco-cinerea; anfract. ad 10 convexiusculis, plicis circiter 10 convexiusculis, arcuatis compressis instructis, et filis ad 5 volventibus cinetis: tribus ultimis varice munitis: apertura parva, subcircularis, nitidè rufo-nigra; basi vix effuso et contorto; labro expanso. Pl. —, fig. —.

Shell elongated, turreted, slender, solid, rough, and dusky, composed of ten closely revolving moderately convex whorls, ornamented with about 16 longitudinal curved, compressed folds, and about five revolving threads, which usually form beads where they crown the folds; the three anterior whorls are fortified with a strong varix, about two-thirds of a revolution distant from each other. Aperture small, nearly circular, slightly produced and contorted at base, very dark and glossy liver-brown within; lip roundly overted.

Length $1\frac{1}{4}$ inch, breadth two-fifths of an inch.

Locality.—Brought from San Diego by Dr. Tho. H. Webb and Wm. P. Blake.

This shell is apparently very common, and yet I find no description answering to it. From *P. sacratum*, Gould, it may be distinguished by its small and dark colored aperture, and the longitudinal folds. It is much like *P. iostoma*, Pfeiffer, a Cuban species. Some of the specimens are very much more slender than others.

PHASIANELLA COMPTA, Gould.

Testa parva, solida, ovato-conica, imperforata, polita, cinerascens. Lineis minutis oblique volventibus olivaceis ornata; spira acuta; anfractibus quatuor rotundatis: ultimo ad peripheriam obtusè angulato, et interdum tessellatam fasciato: apertura circularis; labro tenui, albo; columellâ alba, compressa; faucibus callo albo incrassatis. Pl. —, fig. —.

Shell small, solid, ovate, imperforate, smooth and shining, ashy white, minutely and closely lineated in an obliquely spiral manner with olive green. Whorls four, well rounded, forming an acute spire, the outer one obtusely angular at periphery, where there is sometimes a delicate catenated range of white and olive spots, aperture nearly circular; lip very thin, showing the lineations on the inner margin: throat coated with bluish white enamel; pillar flattened; white. Operculum patelliform, ivory-like, the outer convex surface marbled black and white: the inner surface black. Pl. —, fig. —.

Length one-fourth of an inch; diameter one-fifth of an inch.

Locality.—Found at San Diego by Mr. Blake and also by Mr. Webb.

This pretty little shell is usually more or less coated with cretaceous matters, but when cleaned exhibit a beautifully lineated surface, peculiar on account of the lines running so nearly in the ordinary direction of revolving striae. The coloration, however, sometimes consists of olive and white tessellations and blotches. It would accord pretty well with *P. perforata*, Philippi, did it not lack the distinguishing mark of that species, its perforation.

BULLA (TORNATINA) INCULTA, Gould.

Testa minuta, solidula eburnea elongato-ovalis, longitudinaliter minutissime striata; spira elevata; anfractibus quatuor tabulatis; apertura linearis, octantes. septem longitudines testae adequans, anticè dilatata, posticè rotundata: labro incurvato: columellâ satis arcuatâ, callossâ uniplicatâ. Pl. —, fig. —.

Shell minute, solid, ivory white, elongated-oval, minutely striated longitudinally; spire elevated, consisting of about four tabulated whorls. Aperture about seven-eighths the length of the shell, not attaining the end of the outer whorl, linear, constricted at the middle and somewhat dilated anteriorly, posterior angle rounded; pillar moderately arcuate, usually presenting a well marked fold at the anterior fourth and well coated with enamel.

Length one-eighth; breadth one-twelfth of an inch.

Locality.—San Diego.

May be best compared with *B. fusiformis*, A. Adams, and is also very closely allied to *B. obstincta*, Gould. The spire varies much in elevation, sometimes, indeed, being on a level with the outer whorl. The form of the whorl shell is also more or less cylindrical.

BULLA (HAMINEA) VESICULA, Gould.

Testa parva, fragilis ovato-globosa, palidè citrina, posticè truncata; apertura spiram superans, longitudine duplo adequans, anticè et posticè benè rotundata; columella profundè arcuta, vix callosa. Pl. —, fig. —.

Shell small, fragile, ovate globose, pale greenish yellow; body of the shell small, truncate at summit; outer whorl large; aperture about twice the length of the body of the shell, and projecting above it, broadly rounded both posteriorly and anteriorly; outer lip inflexed at the middle; pillar profoundly arcuate, with a narrow delicate callus.

Length ; breadth

Locality.—Brought from San Diego by Mr. Blake.

It has about the size and general appearance of *B. rotunda*, A. Adams, but has not so large a body, and is more open anteriorly; in this latter respect it is more like *B. Natalensis*, a much larger shell.

CARDIUM CRUENTATUM, Gould.

Testa parva, tenuis, transversim rotundato-ovata, ventricosa, inequilateralis, polita, straminea, ad aream dorsalem posticam rufò

tineta, lineis radiantibus crebris vix insculpta; umbonibus eminentibus obtusis; extremitatibus rotundatis, rufo, biradiatis; intus citrina, sanguineo conspersa; margine argente crenulato. Pl. —, fig. —.

Shell small, thin inequilateral, rounded ovate, moderately ventricose, surface smooth and shining, with very delicate lines of growth, and numerous, indistinct, radiating striae, more distinct posteriorly and near the margin: anterior and broadly rounded; posterior end narrowed, semi-rhomboidal, the dorsal margin rather rapidly declining; color pale lemon, or straw-color, somewhat discolored or blotched with rufous, the beaks biradiate with brown, and the posterior dorsal area brownish; interior bright lemon-color, beautifully stained with dark liver-brown, especially near the beaks and posteriorly; inner margin minutely crenulated. Height and length five-eighths of an inch; breadth three-eighths of an inch.

Locality.—Inhabits San Pedro.—*Wm. P. Blake*.

Compared with *C. Elenense*, Sowb., it is much less elevated and differently colored, though the general characters are very closely allied. It is more like *C. Mortoni*, Con., but is less solid, more inequilateral, less truncate posteriorly and more freely colored within, and the internal margin in that shell is not crenulated.

TAPES GRACILIS, Gould.

Testa parva, tenuis, inequilateralis, elongato-ovata, albida, obsoletè, fusco radiata, ad aream dorsalem posticam fuscata, concentricè, striolata; extremitatibus rotundatis, extr. antico acutiore: intus candida. Pl. —, fig. —.

Shell small, thin, transversely elongate-ovate, rather compressed, beaks, at the anterior third, whitish, with traces of dusky radiations on the disks, and clouded with dusky or the dorsal areas; surface with very fine concentric lines of growth, coarser at the ends: extremities rounded, the posterior somewhat obliquely, the anterior narrower and somewhat more acute; anterior dorsal area depressed, without any line of demarcation; interior white.

Length three-fourths of an inch: height half an inch: breadth an eighth.

Locality.—Brought from San Pedro by Mr. Blake.

Belongs to the group with *T. Florida* and *geographica*, but in less inequilateral and less angular than those shells. It may grow much larger than the present specimen, and is pretty certain to vary in coloring.

In addition to the preceding are two or three species left undetermined in consequence of imperfect specimens, or because the characters are not sufficiently marked to render their novelty decisive. The following remarks may be added in regard to some of these:

(1.) *MYTILUS EDULIS*, or very closely allied. It seems to differ in having the dorsal angle at a greater distance from the beak—the posterior dorsal slope more rapidly declining and more curved, as in *M. hamatus*—the interior more pearly, and the margin more uniformly deep black.

Locality.—San Francisco.—*W. P. Blake*.

(2.) *OSTREA*.—A small parasitic *Oyster*, on twigs, probably of *Gorgia*, usually projecting equally to either side. The form is elliptical, the under valve having a groove for the twig, with a corresponding eminence in the upper valve: sometimes it adheres by but one edge, and then assumes an oblique, alate form, like *Avicula*. It is quite thin, lincated, radiately ornamented with fascicles of brown lines.

Locality.—San Diego.—*W. P. Blake*.

Another oyster from San Diego, about two inches long, narrow and moderately widening, slightly sigmoid in form, its margins simple and the extremity somewhat truncate and undulate or dentate, with by four or five radiating grooves: shell compact, upper valve purplish. It occurs in clusters intimately grouped, much like the parasitic oysters of Carolina, but more elongate, less degitate at the end, less cavernous under the beak, and less black within.

Locality.—San Diego.—*W. P. Blake*.

(3.) *PECTEN*.—A large turgid species, like *P. gibbus* or *purpuratus*, and no doubt described. It has about twenty ribs, which are square and a little broader than the interspaces, which are scaly.

Locality.—San Diego.—*W. P. Blake*.

ARTICLE III.

NOTES UPON SILICIFIED PLANTS FOUND FOSSIL IN CALIFORNIA BY
W. P. BLAKE, GEOLOGIST OF THE EXPEDITION UNDER THE COM-
MAND OF LIEUTENANT R. S. WILLIAMSON.

Among the boulders of syenite, greenstone, and similar rocks piled in confusion along the banks of Kern river, a short distance below the ford; I found a mass of yellow rock, siliceous and jaspery in its character, that was filled with silicified fossil stems, traversing it in every direction. These stems were so completely preserved that every cell and tube was distinctly visible, and the cross fracture showed the organization beautifully. The diameter of the stems is about half of an inch, and they vary in length from one to three inches and more; but they could not be detached from the rock except in fragments.

The boulder containing these beautiful fossils was about 18 inches in diameter, and numerous specimens were procured from it. It must have been transported from the head waters of the river, or from the sedimentary beds a short distance above, having been broken out by the undermining action of the stream. It is very desirable that the original locality of these fossils should be discovered and their geological associations made known.

It is probable that the examination of the rock *in situ* would develop many interesting forms not found in these transported masses.

Similar fossils were afterwards found "in place" near the summit of the Sierra Nevada, in the pass called the Cañada de las Uvas. They were on the eastern slope, and, therefore, within the limits of the

Great Basin. They constitute beds, with a combined thickness of several feet, lying interstratified conformably with sandstone strata, probably of tertiary age. These beds are almost wholly composed of these stems, closely matted together and twisted in various directions. The color of the fossils is very different from those on the banks of Kern river, being a light blueish-grey, while the former are yellow or drab. Their size is also different; but in the appearance and characteristics of their organization, as shown by a cross fracture, they appear to be identical. It is evident that the Kern river boulder was not derived from this locality, and that another deposit must exist.

Specimens from Kern river have been ground down and polished by a lapidary, and the internal structure is beautifully displayed by them.* These specimens, and others from the Great Basin, were submitted to Professor J. W. Bailey, of the United States Military Academy at West Point, who has kindly examined them microscopically, and has drawn an elaborate figure showing their structure.

The following is a copy of his letter accompanying the drawing :

WEST POINT, *New York*, March 22, 1855.

DEAR SIR: I send herewith a sketch of the structure of the fossil plant from the boulder in the bed of Kern river, (west slope of the Sierra Nevada.)

The plants, as far as I can make out the structure, are annual shoots of an exogenous structure, presenting a distinct pith, (p. in the drawings); medullary rays (r); a layer of liber (l); and a loose succulent bark (b), having large lacunæ (la). In the outer portion of the wood a series of large vessels, v 1; of smaller, v 2; and of still smaller ones, v 3, are placed. I could not detect upon these vessels any indications of spiral or dot.

The specimens from the east slope of the Sierra agree in all essential points with the above, the only difference noticed being the development of a few large vessels surrounded with woody fibre within the pithy portion.

I cannot venture with the limited data furnished above to form any opinion upon the affinities of these plants.

The vertical section, fig. 1, is made up from observations of various splinters from different parts of the plants which I encased in Canada balsam. The horizontal section, fig. 2, is from the section made by the lapidary in New York, which I afterwards rubbed down to half the thickness the lapidary had given. The section thus obtained was as perfect as if from a recent plant. It showed the cells filled with transparent silica, and in the larger lacunæ the arrangement of the silica into small spherical agates was distinctly visible.

Yours, very respectfully,

J. W. BAILEY.

W. P. BLAKE, Esq., *Washington, D. C.*

* Several other sections of these fossils are being prepared, and the results of their examination will be presented in the final report.

ARTICLE IV.

NOTICE OF THE FOSSIL FISHES FOUND IN CALIFORNIA BY WILLIAM P. BLAKE, GEOLOGIST OF THE UNITED STATES PACIFIC RAILROAD SURVEY UNDER THE COMMAND OF LIEUTENANT R. S. WILLIAMSON, UNITED STATES TOPOGRAPHICAL ENGINEERS; BY LOUIS AGASSIZ.

Most of the fossil remains of fishes placed in my hands by Mr. Blake for examination and identification belong to the family of sharks, one belongs to that of skates, and another is remotely allied to the family of mackerels. No fossil sharks' teeth having been found west of the Rocky mountains before, the discovery by Mr. Blake of a variety of species belonging to several genera of the family of sharks constitutes one of the most interesting additions to our knowledge that could have been obtained from that quarter, and the importance of these fossils to science is further enhanced by the peculiar relations they bear to similar fossils found in the Atlantic States and in Europe and to the sharks now living along the shores of the old and of the new world.

ECHINORHINUS, *Blainv.*

1. E. BLAKEI, Agassiz, pl. —, fig. —. The most interesting and important discovery since the publication of the *Poissons Fossiles* is that of the tooth of the genus *Echinorhinus*, in the tertiary deposits of Ocoya creek, (Posé creek,) at the western base of the Sierra Nevada, California. The genus *Echinorhinus* was founded by Blainville for the *Squalus spinosus* of Linnaeus, the only species of the genus thus far known which inhabits the Mediterranean and the European and African coasts of the Atlantic.

I figured the teeth of the same genus under the name of *Goniodus* for the same species. (see *Poissons Fossiles*, vol. iii, p. 94, pl. E, fig. 13,) so that this name must give way to the *Echinorhinus* of Blainville.

The discovery of a fossil species of this genus in the tertiaries of the western slope of the Sierra Nevada is not only important as carrying back this curious type of sharks to a period older than ours, but also in disclosing the existence upon the American continent of types in a fossil state known in the old world only among the living. The fossil species of *Echinorhinus* differs from the living, having the main point of the tooth more prominent, and at the same time shorter, an appearance which arises from the less prominence of the marginal denticles. This difference may be distinctly seen by comparing the figures pl. —, with those of the living species given in *Poissons Fossiles*, pl. E, fig. 13.

SCYMNUS, *Cuv.*

2. S. OCCIDENTALIS, Agassiz.—The few species upon which Cuvier founded the genus *Scymnus* have been of late subdivided by Müller and Henle into two genera: *Scymnus* proper, and *Læmargus*; all of

which are only known among the living. It is another of the highly interesting discoveries of Mr. Blake, to have brought home two teeth from the tertiaries of California belonging to this remarkable type. I would even not hesitate to consider them as indicating a distinct genus, were the number of specimens sufficient to warrant the inference that the teeth present, in every position of the mouth, as great a difference from the *Scymnus* and *Lamargus* as the two latter present when compared with one another. At all events, the teeth belong to the genus *Scymnus*, as established by Cuvier, and it constitutes a very distinct species on account of the strong bend backwards of the main point of the tooth, and the distinct and rather marked serration of the edges of the crown. Moreover, the inclination of the central point upon its basis gives these teeth a certain resemblance with those of *Spinex* and *Centrophorus*, and still more with *Galeocerdo*. The connexion of the teeth of the same row of the jaw with one another, was evidently the same as in the *Scymnus* and *Lamargus*, as is plainly shown by the notch upon the inner surface of the root, and the articulating tubercle at the base of the enamel in both sides.

The discovery of a fossil *Scymnus* in the tertiaries of California is particularly interesting in a geographical point of view, since thus far no representative of the type has been found in the Pacific ocean.

GALEOCERDO, Müller and Henle.

3. *G. PRODUCTUS*, Agass.—Two species only of living *Galeocerdo* have been known thus far—one from the Indian ocean and one from the Atlantic. The fossil species have been traced from the chalk to the upper tertiaries.

The Atlantic States have already yielded satisfactory indications of the presence of this genus during the tertiary period, on the eastern coast of America. Now we receive from the collection of Mr. Blake a new addition to the range of this remarkable genus. The new species he has discovered resembles so closely the *Galeocerdo Adoncus* from the Eocene of Europe, especially common in the Molasse of Switzerland, that were there not several specimens in the collection agreeing with one another in every respect, and unitedly differing from those in the Old World, I would have been at a loss to distinguish them. The California species differ chiefly from the European in having the anterior margin of the tooth less arched, with much more minute crenulations, and the serratures on the basilar margin rather smaller.

PRIONODON, Müller and Henle.

4. *P. ANTIQUUS*, Agas.—Thus far no fossil shark of the tribe of *Carcharias* has been known among the fossils, and, as shown in the *Poisson Fossiles*, all the species formerly referred to the genus *Carcharias* have been ascertained to belong to the genus *Carcharodon*. Few discoveries in this field could, therefore, be of more interest than finding among the tertiaries of Ocoya creek a number of teeth agreeing in the deep notch upon the base of the root, but differing in their width as well as in the shape of their edge; belonging evidently to the genus

Prionodon of Müller and Henle. The larger and broader ones having the edges serrated, especially near the base, while the narrower ones are smooth and sharp. These differences correspond exactly to the differences observed by Müller and Henle between the teeth of the upper and lower jaw in some species of the genus Prionodon. A transverse section of the fossil under consideration shows, moreover, these teeth to have a central cavity, as in those of the whole tribe of Carcharias. There can, therefore, be no doubt that we have here the first instance of a fossil species of the type of Carcharias of the genus Prionodon, which it will be possible, under all circumstances, to distinguish from Sphyrna by the difference in the shape and serrature of the teeth in the upper and lower jaw. The species may be designated under the name of *Prionodon antiquus*.

My *Galeocерdo denticulatus*, from Maestricht, may, however, belong to this genus. The tooth of this species being rather erect, while in Galeocерdo the crown of the tooth is bent backward, and its posterior margin is deeply notched. In *Prionodon antiquus*, as well as in *G. denticulatus*, the crown is but slightly inclined backwards, and though it tapers rapidly to a conical point, that point does not stand so distinctly out from its base as in true Galeocерdo.

HEMIPRISTIS, Agass.

5. H. HETEROPLEURUS, Agass.—The genus Hemipristis was established by me from fossil teeth of the middle tertiaries of Europe. Dr. R. W. Gibbes has since indicated their existence among the tertiaries of the Atlantic shores of America, and now we owe to Mr. Blake the discovery of a tooth of this genus in the deposits of Ocoya creek, California.

I have already remarked how difficult it is to perceive the difference existing between Galeocерdo Adoncus of Europe, and the species of that genus existing in California. I am still more doubtful about the propriety of distinguishing the species Hemipristis of the west from those of Europe. It would seem extraordinary, however, to find the same species of sharks extending from the Pacific coast of this continent to central Europe, especially when we find, upon closer examination, our living sharks more closely circumscribed within narrow limits than was formerly supposed. And yet all the differences I perceive between the Hemipristis of California and those of Europe consist in a marked inequality between the serrature of the hinder margin when compared with that of the anterior margin of the tooth. As this may be found to be a constant character, I would introduce the western species provisionally, under the name of *H. heteropleurus*, or until the discovery of more specimens decides whether this difference in the serrature of the margin of the inner sides of the teeth is constant or not.

CARCHARODON, Smith.

6. C. RECTUS, Agass.—Of all the types of sharks' teeth that of Carcharodon, next to Lamna and Oxyrhina, is the most numerous in the tertiary deposits, though there is only one living species known.

Mr. Blake has brought a finely preserved specimen of a medium sized species of this genus from California. Rather smaller than *Carcharodon angustidens*, the tooth has the same form as that species, only that there are no accessory points upon the sides of the base. Considering its size this tooth is remarkable for its thickness, and in that respect it reminds one more of *Carcharodon angustidens* than any other species. The surface is flat and the tooth straight, as in *C. angustidens*, and to this character the name *rectus* is intended to allude.

Several species of this genus have been described by Dr. R. W. Gibbes as occurring in the tertiary of the Atlantic slope.

OXYRHINA, Agassiz.

7. *O. PLANA*, Agas.—Since the teeth of Oxyrhina are known to differ in size so widely as they do in the different parts of the jaws, nothing is more difficult than to combine fossil teeth found separated in such a manner as to leave no doubt about their specific identity. Several teeth of a very interesting species of Oxyrhina are found among the specimens of fossils brought by Mr. Blake from California, and its resemblance to the *O.*—— of the Mediterranean is very striking. But the character by which they differ most strikingly from the living species and the fossils already described consist in the greater flatness of the teeth as compared with their width. Some of them are straight, and others slightly bent backward. This species I propose to name *O. plana*.

Several species of this genus have been described from the Atlantic States by Dr. R. W. Gibbes.

8. *O. TUMULA*, Agas.—The existence of a second species of the genus Oxyrhina in the tertiary of California is indicated by several teeth remarkable for the size and thickness of the roots as compared with the lengths of their curves. The specimens agreeing in this character differ greatly in size, and yet not more so than may be seen in the same jaw of our living species.

Found with the preceding by Mr. Blake.

LAMNA.

9. *L. CLAVATA*, Agas.—Two teeth from Ocoya creek indicate the existence in California of a species of Lamna allied to *L. cuspidata* of the European Miocene, from which it differs, however, by its smaller size, its shorter and narrower crown, in which respect it agrees more with *L. Hopei* of Sheppy. The crown, however, is less arched than the latter. The posterior surface is smooth as in *L. cuspidata*.

Found with the preceding in the tertiary formation of Ocoya creek.

10. *L. ORNATA*, Agass.—A second species of Lamna has been brought from California by Mr. Blake. It occurs in the sandstone of Navy Point, Benicia, and is allied to *L. elegans*, Agass. (See *Recherches des Poissons Fossiles*, vol. iii, p. 289.) It is, however, a smaller species, and tapers more gradually, while in *L. elegans* it tapers more

suddenly near the top, and the folds of the enamel on the inner side of the tooth are coarser. The base of the tooth is more compressed than in *L. elegans*, in which respect the tooth resembles more *L. acuminata*.

The small tooth found with the specimen may be one of the lateral teeth of the same species; but it is difficult to determine this without a microscopical examination of its structure. These fossils are unquestionably of tertiary age. *L. elegans* is found in the Calcaire grossier in the environs of Paris, and in the London clay at Sheppy. The same species is also found fossil in the Crag, having been transported with the remains of many other species from the London clay. Several species of this genus have been described from the Atlantic States by Dr. R. W. Gibbes.

ZYGOBATES, Agass.

11. z. ———?—A fragment of a tooth of the genus zygobates is interesting inasmuch as it shows that this genus of the order of the family of skates, with pavement-like teeth, to have occurred in California during the tertiary period; though the fragment of the tooth before me is too imperfect to allow the species to be identified. It may not be out of place to remark that no species of this genus, or the allied genera Rinoptera, Ætobates, or Myliobates have thus far been found in the Pacific ocean.

Several fragments of bone found with the teeth at Ocoya creek (Posé creek) belong to the family of Scomberoides, but are too imperfect to admit of being identified.